Testing Weak Form Efficiency of Indian Stock Market – An Empirical Study on NSE

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Abstract:

The Efficiency Market Hypothesis (E M H) has been consented as one of the cornerstones of modern financial economics. The term "efficiency market" in financial literature in 1965 as one in which security prices fully reflect all available information .The market is efficient if the reaction of market prices to new information should be instantaneous and unbiased.

Like its foreign counterparts, Indian stock market is also affected badly by the financial crisis of recent times. Last five years have seen several crashes in the stock market followed by unprecedented volatility. Millions of the investors' money have wiped out in seconds. In this context, the issues of efficiency of the Indian stock market have again become relevant at all levels. With this backdrop, the present study attempts to reinvestigate the true level of information efficiency of Indian stock exchanges, with a special reference to National Stock Exchange.

The paper is to empirically study on testing weak form efficiency of Indian stock market – with special reference to NSE. The objective of the study is to check whether NSE is efficient in weak form of market. The study is analytical in nature and used secondary data analysis to attain its objectives. The secondary data is collected from the official website if nseindia. com covering the last fourteen five years from January 2000 to December 20132008-09 to 2012-13. Various other reports like magazines, journals, published books and official websites are also referred to for the present study. The statistical techniques applied for data analysis in the present study are run and auto correlation tests. The results depicts that NSE is inefficient in weak form of market.

Introduction:

The Efficiency Market Hypothesis (E M H) has been consented as one of the cornerstones of modern financial economics. we first defined the term "efficiency market" in financial literature in 1965 as one in which security prices fully reflect all available information .The market is efficient if the reaction of market prices to new information should be instantaneous and unbiased .Efficiency Market Hypothesis is the idea that information is quickly and efficiently incorporated into asset prices at any point in time, so that old information cannot be used to foretell future price movement.

Like its foreign counterparts, Indian stock market is also affected badly by the financial crisis of recent times. Last five years have seen several crashes in the stock market followed by unprecedented volatility. Millions of the investors' money have wiped out in seconds. In this context, the issues of

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efficiency of the Indian stock market have again become relevant at all levels.

With this backdrop, the present study attempts to reinvestigate the true level of information efficiency of Indian stock exchanges, with a special reference to National Stock Exchange being the greatest and public limited registered stock exchange of the country.

Market Efficiency – Conceptual Aspect:

Definition of Market Efficiency:

Market efficiency, in its true sense can be operational, allocation or informational. However the one most interesting and debatable is the informational efficiency. An efficient capital market is defined as one in which security prices always adjust instantaneously and in an unbiased manner to any new information becoming known to the market, thus leaving no scope for any market participant to earn above normal return on a consistent basis over a long period of time.

Forms of Market Efficiency:

Depending upon the information set that is fully reflected in security prices, Eugene Fama (1970) classified efficient capital markets into the following three forms:

a. Weak Form Efficiency

The information set available in such a market is past sequence of security prices. Since past price data cannot be used to predict future security prices as these are already impounded in the stock prices, evidences on random walk hypothesis (i.e. independence of successive price changes) would generally confirm the weak form of efficiency in capital markets.

b. Semi-strong form efficiency

The semi-strong form of efficient capital market hypothesis says that stock prices adjust to all information both past information and also other publicly available information such as annual earnings announcements, stock splits, interim dividend etc. This implies that using publicly available information investors will not be able to earn superior risk adjusted returns.

C. Strong form efficiency

The information set available in such a market is all information both publicly available and inside information and strong form of efficiency will imply that the stock price will incorporate all those information.

Since different forms or levels of efficiency require progressively more amount of information impoundment, various customised test techniques are applied to confirm such forms

Implications Market Efficiency:

The concept of market efficiency useful in different ways.

a. An Analyst's Perspective:

- Technical analysis based on the chartist techniques is completely useless if the market is efficient in the weak form.
- If the market is efficient in the semi-strong form, trading strategies

based on even publicly available price sensitive information will yield no excess return.

b. An Investor's Perspective:

- If market is efficient chance of gain and loss is 50:50. Therefore, so long the efficiency is maintained an average investor should simply select a suitability diversified portfolio, thereby avoiding cost of analysis and transaction.

c. A Corporate Manager's Perspective:

  - If the market is efficient any manipulation in accounting treatments will be property interpreted by the investors and analysts. Hence, earnings management will be of no use.
  - If the market is efficient the timing of security issue does not have to be fine-tuned.

d. Societal Perspective:

  - An efficient market will always ensure capital flow to the most optimal use.

Literature Review:

The history of researches on market efficiency is almost a century old. Innumerable studies had been conducted around the world on this issue. In India also a systematic endeavor was seen in this respect as early as 1970s. since then issue of market efficiency has been researched in India providing considerable evidence that Indian stock market, if not in semi-strong form, is efficient in weak form is this respect Barura (1980-1987). Sharma (1983). Ramchandran (1985). Sharma and Kennedy (1977), Gupta (1985) been a few studies also for example, by Kulkarni (1978) and Choudhury (1991) which did not support the weak form efficiency.

However, in a few recent studies P. Srinivasn (2012). Das and Pattanayak (2011), P.K. Mishra and Gupta & Siddikiargued that advanced test results of a few well known indices showed considerable departure from randomness.

The issue of semi-strong form of efficiency was taken up for research from mid 1980s. the evidences on this issue, however are mixed Ramchandran (1985) and Srinivasan (1988) found that the market is by and large efficient in responding to the information content of bonus issue and right issues respectively, Dixit (1986) showed that dividend is the most important determinant of the share prices. However Barda and Ragbunathan (1990), Sundaram (1991), Obaidullah (1991), Sinha ((19992) cast doubts on whether the observed price a\earnings rations are consistent with the fundamental factors like dividend growth and payment rations. Moreover Barua and Raghunathan (1986) provide evidence of the systematic mispricing of the convertible securities in violation of the risk-return parity and argue that this represent and arbitrage opportunity.

On strong form efficiency there is hardly and notable study as Indian stock market can hardly be expected to the efficiency in the strong form mainly because of its limited size, less stringent regulations to avoid insider trading mechanisms etc.

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Thus is appears that there is no consensus among the researches regarding the true level of market efficiency achieved be the Indian stock market. Further the recent turmoil and resultant increased volatility of stock exchange have put a question mark on the efficiency of Indian stock exchange to a great extent. This provides us the impetus to reinvestigate the issue of market efficiency of Indian stock market.

Meredith beechry,David,Gruen,James,Vickery.The efficient market hypothesis states that assets prices in financial market should effect all available information; as a consequence prices should always be consistent with fundamentals.

The paper discusses the main ideas behind the efficient market hypothesis and provided a guide as to which of its predictions seem to be borne out by empirical evidence and which do not. The evidence suggests that it cannot explain some important and worrying features of asset market behaviour. Investors' inconsistency, transaction cost and unavailable information may all be source of market inefficiency, study their impact, as well as the influences of other conditions on the development of prices in the primary goal in the empirical literature.

Objective of the study:

1. To check whether National Stock Exchange is in weak form of efficiency considering a long period data applying detail statistical analysis.

Hypotheses: Run and Auto correlation tests are used at 95% confidence level to know whether National Stock Exchange is efficient in weak form of market

I. Run test:

Null Hypothesis (HO) – price change is random.

Alternative Hypothesis (H1) – price change is not random.

II. Auto Correlation Test:

Null Hypothesis (HO) – There is no serial correlation.

Alternative Hypothesis (H1) – There is serial correlation.

Methodology:

For the purpose of this study, NSE popular index known as S&P CNX Nifty was considered. The reason for selecting this index is that it sufficiently captures the mood of the market. To reach index under study, a sample period starting from January 2000 to December 2013 was considered. Monthly closing index values under study were collected for the above said period.

The return is calculated as the logarithmic difference between two consecutive prices in a series, yielding continuously compounded returns. The reasons behind considering logarithmic return are justified by both theoretically and empirically. Theoretically, logarithmic returns are analytically more tractable while linking returns over longer time intervals. Empirically, logarithmic returns are more likely to be normally distributed which is prior condition of most standard statistical techniques. Daily index returns (Rm.t) are calculated as.

Rm.t = Ln (It / It 1)

Where, R t = return at period t, It = index at period t and t-1 = index at period t-1

Ln = natural log.

Statistical test techniques are applied on the return series using various statistical packages like SPSS in addition of Excel 2007.

Test Techniques Applied:

Since weak form efficiency necessarily imply that past price information cannot be used to predict future security price as these are already impounded in the stock prices, evidences on random walk hypothesis (i.e. independence of successive price changes) would generally confirm in the weak form of efficiency in capital markets. Therefore tests of randomness of return series have been considered as extremely useful over the years in assessing weak form of market efficiency. In this study we have used both parametric Serial Correlation Test and non-parametric Run Test to judge random behaviour of index returns under study.

I. Run Test

A "run" of a sequence is a maximal non-empty segment of the sequence consisting of adjacent equal element. For example, the sequence "++++---+++-------++++++----"consists of six runs, three of which consist of +s and the other of –s. If +s and –s alternate randomly, the number of runs in the sequence N for which it is given that there are N+ occurrences of + and N- occurrence of –(so N=N+ + N-) is a random variable whose conditional distribution – given the observation of N+ positive runs and N- negative runs is approximately normal with mean (μ) and standard Deviation (σ).

These parameters do not depend on the "fairness" of the process generating the elements of the sequence in the sense that +s and –s must have equal probabilities, but only on the assumption that the element are independent and identically distributed. The hypothesis of statistical independent of the elements may be rejected.

Runs test can be used to test

1. The randomness of a distribution, by taking the data in the given order and marking with + the data greater than the median (Numbers equalling the medians are omitted)
2. Whether a function fits well to a data set, by marking the data exceeding the function value with + and other data with-. For this use, the runs test, which takes into account the signs but not the distances, is complementary to the chi-square test, which takes into account the distances but not the sings.

Run test statistics is a kind of non-parametric statistical test that checks a randomness hypothesis for a two –valued data sequences. More precisely, run test can be used to test the hypothesis that the elements of the sequence are mutually independent one. A run of a sequence is defined as a maximal non-empty segment of the data sequence consisting of adjacent equal element.

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Run test can be used to perform

- Randomness of a distribution is found by taking the data in the given form or order and marking with + the data greater than the median and with – the data less than the median.
- Numbers which equal the median get omitted.
- It checks whether a function fits well to a data set values, by marking the data exceeding the function value with +and the other data with –. It mainly depends on signs.
- If the number of runs falls outside the interval of universally accepted is μ+-1.96, then it is reasonable to reject the hypothesis and that the curve is a good description of the data.

Mean= {[2(N+) (N-)]/N} +1

Variance σ2= {2N+N– (2N+N-N)}/ {N2 (N–1)} = {(μ-1) (μ-2)}/ (N-1)

Where

N=(N+)+(N-)

N+= positive runs or number of occurrences of +s

N-=negative runs or number of occurrences of –s

If the sample size is unequal and either n1 and n2 is larger than 20, or if the sample size is equal and large than 100, then the test statistical is

Z= {r-(2 n1 n2)/ (n1 + n2) +1}/ {(2 n1 n2 (2 n1 n2- n1- n2))/ (n1+ n2)1/2(n1+ n2-1)} 1/2

Where r (test statistic) is the number of runs or average of the most and fewest runs.

In this study, Run test has been applied on the index return series with cut off point k= median. The hypothesis is that actual number of runs, thereby confirming the presence of weak form efficiency.

II. Serial / Auto Correlation Test:

Serial correlation (also called Auto-correlation) measures the correlation between price changes in consecutive time period. Hence, a serial correlation that is positive and statistically significant could be viewed as evidence of price momentum in markets and would suggest that returns in a period are more likely to be positive (negative) if the prior period's returns were positive (negative). Similarly a negative serial correlation, which is statistically significant, could be an evidence of price reversals. **But if the serial correlation is found to be zero or statistically insignificant, it will confirm independence of successive price changes and will evident weak form efficiency of the market.**

In this study, we have used serial correlation test with **null hypothesis that the autocorrelation coefficients are equal to zero (implying that NSE is efficient) against the alternative that they significantly deviate from zero (implying that it is inefficient).**

Serial/Auto correlation function for the series Yt is measured by the formula;

$$ACF(k) = \frac{\sum_{(t=k-k)}^{n} (yt - \bar{y})(yt - k - \bar{y})}{\sum_{(t=1)}^{n} (yt - \bar{y})^2}$$

The standard error of ACF (k) is given by:

$$Se_{ACF(k)} = \frac{1}{\sqrt{(n-k)}}$$

When n is sufficiently large i.e. n>50, it is reduced to

$$Se_{ACF(k)} = \frac{1}{\sqrt{(n)}}$$

To test whether ACF (k) is significantly different from zero, we have used t statistic where

$t = ACF(k)ISe_{ACF(K)}$

Further to test the joint hypothesis that all autocorrelations are simultaneously equal to zero, the Ljung-Box portmanteau statistic (Q) is used. The Ljung-Box Q statistics are given by:

$$Q^* = T(T+2)\sum_{k=1}^{m}\frac{\hat{r}_k^2}{T-k} \sim \chi_m^2$$

Where tk(k)is the autocorrelation, T is the number of observations and m is the maximum lag. Under the null hypothesis of zero autocorrelation at the first m autocorrelations (r1 = r2 = r3 = … = rm = 0), the Q-statistic is distributed as chi-squared with degrees of freedom equal to the number of auto corrections (k).

Empirical Results:

1. Run Tests:

The run tests convert the total number of runs into a Z statistic. For large samples the Z statistic gives the probability of difference between the actual and expected number of runs. The Z values is greater than or equal to + 1.96 or prob. value less than 0.05 rejecting the random walk hypothesis at 5% level of significance. The index depicts that the successive price changes are not independent and the series is not random since its Z value (2.012) is greater than 1.96 as well as prob. value is 0.044 which is less than 0.05. Hence, it rejects null hypothesis that there is random series.

2. Serial/ Auto Correlation Test:

The results of serial correlation test have been incorporated. Our analysis reveals that auto-correlations are significant at 5% level in a quite few cases for index. For S&P CNX Nifty, auto-correlations are significant for 3, 4, 8, 11, 14, 17,19,24,25,26,27,37,40, and 42th lag. Thus almost 3333% of the 168 auto corrections calculated are significant at 5% level. The index exhibits significant correlations which are in clear contradiction of our assumption of zero and insignificant auto-correlation of returns at different lags. However, the results are not conclusive enough as all lags do not show significant auto-correlation. Hence, as a confirmatory analysis, findings of Ljung-Box portmanteau statics (Q) can be considered useful in this respect. Our analysis shows that Q statistic is significant (with p value>0.531) at 5% level for all lags. It is also revealed from the

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graphical representation that the data lies within those lines and hence, there is no serial correlation. This clearly rejects the joint hypothesis that all the auto correlations are simultaneously zero and insignificant. Thus the results exhibit clear departure from the random walk assumption. Hence, NSE can never be considered efficient in the weak form.

Conclusion:

The assumption of random walk is central to the existence of a weak form efficient market. This study has attempted to test such phenomenon in National Stock Exchange being of representative of Indian stock market with the help of Serial correlation test (along; with Q statistic) and non-parametric Run test. But the results of both the tests clearly indicate that the return series from the selected index S&P CNX Nifty from NSE do not show any sign of random behaviour and significant dependence do exist among the returns of various time periods. Thus, it will not be wrong to conclude that NSE in specific and hence Indian stock market at large are inefficient in the weak form of market efficiency implying that it is not impossible for investors to consistently earn above normal return with the help of any properly designed trading strategy based on past price movements. This will help for prediction and hypothesis testing.

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Appendix1- Runs Test

			monthly Index Returns
Test Valuea			-.0098
Cases < Test Value			84
Cases >= Test Value			84
Total Cases			168
Number of Runs			98
Z			2.012
Asymp. Sig. (2-tailed)			.044
Monte Carlo Sig. (2-tailed)	Sig.		.050[b]
	95% Confidence Interval	Lower Bound	.046
		Upper Bound	.054

a. Median

b. Based on 10000 sampled tables with starting seed 2000000.

Appendix 2- Autocorrelations

Series: monthly Index Returns

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Lag	Autocorre-lation	Std. Errora	Box-Ljung Statistic		
			Value	df	Sig.b
1	.048	.076	.393	1	.531
2	-.012	.076	.419	2	.811
3	.068	.076	1.215	3	.749
4	.081	.076	2.364	4	.669
5	-.043	.076	2.688	5	.748
6	-.024	.075	2.787	6	.835
7	-.039	.075	3.057	7	.880
8	-.102	.075	4.903	8	.768
9	.045	.075	5.271	9	.810
10	.018	.074	5.329	10	.868
11	-.060	.074	5.976	11	.875
12	.018	.074	6.034	12	.914
13	-.001	.074	6.034	13	.945
14	-.065	.073	6.829	14	.941
15	.015	.073	6.870	15	.961
16	.019	.073	6.935	16	.975
17	-.098	.073	8.764	17	.947
18	-.019	.072	8.834	18	.963
19	.106	.072	10.998	19	.924
20	-.005	.072	11.003	20	.946
21	.009	.072	11.019	21	.962
22	.022	.071	11.112	22	.973
23	-.011	.071	11.137	23	.982
24	.100	.071	13.112	24	.964
25	.073	.071	14.186	25	.958
26	-.133	.071	17.740	26	.885
27	-.080	.070	19.029	27	.869
28	.000	.070	19.029	28	.897
29	.002	.070	19.029	29	.921
30	-.039	.070	19.343	30	.933
31	-.036	.069	19.606	31	.944
32	.015	.069	19.656	32	.957
33	.042	.069	20.022	33	.963
34	.038	.068	20.328	34	.969
35	-.010	.068	20.350	35	.977
36	-.030	.068	20.540	36	.982
37	.058	.068	21.273	37	.982
38	.012	.067	21.305	38	.987
39	-.023	.067	21.420	39	.990
40	-.116	.067	24.402	40	.975
41	-.021	.067	24.506	41	.981
42	.050	.066	25.073	42	.982

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.